

CLAIMS

What is claimed is:

1. A vertically translatable chuck assembly for supporting a workpiece at different locations within a plasma reactor chamber having sidewalls surrounding an interior region, comprising:

a chuck base having a perimeter, an upper surface and lower surface;

at least one support arm extending outwardly from said perimeter to said sidewalls so as to support said chuck base within said interior region;

a workpiece support member having a lower surface and an upper surface capable of supporting the workpiece, arranged above said chuck base upper surface; and

one or more vertical translation members arranged between and operatively connecting said chuck base and said workpiece support member for supporting and vertically translating said workpiece support member relative to said chuck base.

2. An assembly according to claim 1, wherein one or more of said at least one support arm is adapted to provide mechanical, fluid, electrical and/or pneumatic communication from outside the plasma reactor chamber to said chuck assembly.

3. An assembly according to claim 1, further including a match network having a first variable capacitor mounted to said workpiece support member lower surface so as to be in direct electrical communication therewith.

4. An assembly according to claim 3, wherein said match network further includes a first inductor arranged adjacent said first variable capacitor within the chuck assembly between said chuck base upper surface and said workpiece support member lower surface.

5. An assembly according to claim 4, wherein said match network further includes a second variable capacitor arranged within the chuck assembly between said chuck base upper surface and said workpiece support member lower surface.

6. An assembly according to claim 4, wherein said match network further includes a second variable capacitor and a second inductor, each located outside of the chuck assembly and electrically connected to said first inductor through one of said support arms.

7. An assembly according to claim 1, further including one or more utility ports and corresponding one or more utility lines connected to said one or more ports and passing through one of said support arms so as to provide one or more utilities to said chuck assembly.

8. An assembly according to claim 7, wherein said one or more utility ports includes at least one of: a helium port, a nitrogen port, a thermocouple port, a current monitor port, a pneumatic push-pin supply port, an electrostatic clamp port and a voltage probe port.

9. An assembly according to claim 7, wherein said utility lines are gathered into a flexible cable designed to accommodate vertical translation of said workpiece support member relative to said chuck base.

10. An assembly according to claim 1, further including mechanical means for vertically translating said workpiece support member relative to said chuck base.

11. An assembly according to claim 10, further including a vertical drive motor external to the plasma reactor chamber and in operable communication with said vertical translation members through one said support arm.

12. An assembly according to claim 1, wherein said workpiece support member includes one or more cavities adapted to receive and circulate cooling fluid within said workpiece support member, and further including a cooling system arranged external to the plasma reactor chamber and in fluid communication with said one or more cavities via one or more cooling fluid lines passing through one said support arm.

13. An assembly according to claim 1, further including bellows connected at one end to lower surface of the workpiece support member, and at the opposite end upper surface of the chuck base.

14. An assembly according to claim 1, further including a control system coupled to the vertical translation members for controlling their vertical translation.

15. A plasma reactor system for processing a workpiece, comprising:
a plasma reactor chamber having a central axis and sidewalls surrounding an interior region capable of supporting a plasma in an upper part of the interior region;
a chuck assembly arranged adjacent said upper part of the interior region and along the central axis, the chuck assembly including:
a chuck base having a perimeter, an upper surface and lower surface,
at least one support arm extending outwardly from said perimeter to said sidewalls so as to support said chuck base within said interior region,
a workpiece support member having a lower surface and an upper surface capable of supporting the workpiece, arranged above the chuck base upper surface, and
one or more vertical translation members arranged between and operatively connecting said chuck base and said workpiece support member for supporting and vertically translating said workpiece support member relative to said chuck base; and
a vacuum pump system arranged adjacent said chuck assembly opposite said upper part and along the central axis.

16. A system according to claim 15, wherein said vacuum system includes a vacuum pump and a gate valve arranged between the chuck assembly and the vacuum pump.

17. A system according to 15, further including a workpiece load chamber with a sealable door in communication with the interior region and arranged so that a workpiece can be placed into the interior region and onto the workpiece support member.

18. A system according to claim 17, further including a chuck match network, wherein a portion of said chuck match network resides between said workpiece support member and said chuck base.

19. A system according to claim 18, further including an RF power supply connected to said match network through said support arm.
20. A system according to claim 18, further including a cooling system in fluid communication with said workpiece support member via one or more cooling lines through said support arm.
21. A system according to claim 20, further including a gas supply system in pneumatic communication with said interior region, for supplying gas for forming the plasma.
22. A system according to claim 21, further including a workpiece handling system in operable communication with said load chamber, for transporting wafers to and from said workpiece support member through the load chamber.
23. A system according to claim 21, further including a plasma source generator arranged around the outside of the plasma reactor chamber so as to surround the upper part of the interior region.
24. A system according to claim 23, further including a control system in electrical communication with said plasma source generator, said gas supply system, said cooling system, said RF power supply, and said vacuum system, for controlling the operation of the plasma reactor system.
25. A system according to claim 23, further including a control system in electrical communication with said vertical translation members for controlling their vertical translation.
26. A match network for use with a plasma reactor system having a plasma reactor chamber and a vertically translatable chuck assembly having a workpiece support member with a lower surface, comprising:
 - a first variable capacitor mounted to said workpiece support member lower surface so as to be in direct electrical contact therewith; and
 - a first inductor arranged adjacent said first variable capacitor within the chuck assembly and in electrical communication with said first variable capacitor.

27. A match network according to claim 26, wherein the match network further includes a second variable capacitor arranged within the chuck assembly.

28. A match network according to claim 26, wherein said match network further includes a second variable capacitor and a second inductor, each located outside of the plasma reactor chamber and electrically connected to said first inductor.

29. A method of providing a low impedance path between an RF power supply and a workpiece support member with upper and lower surfaces, serving as a chuck electrode in a plasma reactor system capable of supporting a plasma with an associated impedance load adjacent the workpiece support member upper surface, comprising:

providing a match network having a first variable capacitor between the RF power supply and the workpiece support member, including the step of mounting said first variable capacitor to said workpiece support member lower surface so as to be in direct electrical contact therewith; and

tuning said match network to match the impedance load of the plasma so as to minimize the impedance between the RF power supply and the workpiece support member.

30. A method according to claim 29, further including:

initiating the flow of RF power from the power supply through the match network to the workpiece support member.

31. A method according to claim 29, wherein the providing further includes:

providing a first inductor adjacent and proximate said first variable capacitor and electrically connected thereto.

32. A method according to claim 31, wherein the providing further includes:

providing a second inductor removed from said first inductor but electrically connected thereto so that said second inductor is not proximate said chuck workpiece support member lower surface.

33. A method according to claim 31, wherein the providing further includes:

providing a second variable capacitor electrically connected to said first inductor and arranged adjacent said first inductor so as to be proximate chuck workpiece support member lower surface.

34. A method of providing for uniform, substantially axially symmetric flow of plasma gas over a workpiece in a plasma reactor chamber having a central axis and capable of containing a plasma in an upper interior region of the chamber, comprising:

supporting a chuck assembly within the reactor chamber with a plurality of support arms such that gas can flow around the chuck assembly from the upper interior region;

arranging a vacuum pump system along the central axis adjacent the chuck assembly opposite the upper interior region;

providing the workpiece to the chuck assembly such that the workpiece is supported adjacent the upper interior region;

flowing gas into the upper interior region and forming a plasma in the upper interior region; and

activating the vacuum pump system so as to draw gas from the upper interior region over the workpiece and into the vacuum pump system.

35. A plasma reactor system for processing a workpiece, comprising:

a plasma reactor chamber having a central axis and sidewalls surrounding an interior region capable of supporting a plasma in an upper part of the interior region;

a chuck assembly arranged adjacent said upper part of the interior region and along the central axis, the chuck assembly including:

a chuck base having a perimeter, an upper surface and lower surface,

at least one support arm extending outwardly from said perimeter to said sidewalls so as to support said chuck base within said interior region,

a workpiece support member having a lower surface and an upper surface capable of supporting the workpiece, removably arranged above the chuck base upper surface, and

one or more vertical translation members arranged between and operatively connecting said chuck base and said workpiece support member for supporting and vertically translating said workpiece support member relative to said chuck base; and

a vacuum pump system arranged adjacent said chuck assembly opposite said upper part and along the central axis.

36. A plasma reactor system for processing a workpiece, comprising:

a plasma reactor chamber having a central axis and sidewalls surrounding an interior region capable of supporting a plasma in an upper part of the interior region;

a chuck assembly removably mounted within said chamber, arranged adjacent said upper part of the interior region and along the central axis, the chuck assembly including:

a chuck base having a perimeter, an upper surface and lower surface,

at least one support arm extending outwardly from said perimeter to said sidewalls so as to support said chuck base within said interior region,

a workpiece support member having a lower surface and an upper surface capable of supporting the workpiece, arranged above the chuck base upper surface, and

one or more vertical translation members arranged between and operatively connecting said chuck base and said workpiece support member for supporting and vertically translating said workpiece support member relative to said chuck base; and

a vacuum pump system arranged adjacent said chuck assembly opposite said upper part and along the central axis.